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Review

Review of pollutants removed by electrocoagulation and electrocoagulation/flotation processes

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ABSTRACT

The word "electrocoagulation" (EC) will be sometimes used with "electroflotation" (EF) and can be considered as the electrocoagulation/flotation (ECF) process. Through the process of electrolysis, coagulating agents such as metal hydroxides are produced. When aluminium electrodes are used, the aluminium dissolves at the anode and hydrogen gas is released at the cathode. The coagulating agent combines with the pollutants to form large size flocs. As the bubbles rise to the top of the tank they adhere to particles suspended in the water and float them to the surface. In fact, a conceptual framework of the overall ECF process is linked to coagulant generation, pollutant aggregation, and pollutant removal by flotation and settling when it has been applied efficiently to various water and wastewater treatment processes. This review paper considers a significant number of common applications of EC and ECF processes which have been published in journal and conference papers.

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1. Introduction

Electrocoagulation (EC) and electrocoagulation/flotation (ECF) processes can be applied to a broad range of water and wastewater treatment systems and are most effective in removing inorganic contaminants and pathogens. Because of their broad applicability, they have been used for groundwater and surface water remediation at several sites (Joffe and Knieper, 2000). These processes are characterised by ease of operation, reduced production of sludge, and no need to handle chemicals. They have been applied efficiently to various water treatment problems. Therefore, if EC can replace conventional chemical coagulation, very little modification is required to make the present treatment plants more efficient and resolve the many problems caused by chemical coagulation (Rajeshwar and Ibanez, 1997). This research presents information pertaining to the removal pollutants by electrocoagulation in water and wastewater.

Overall, electrocoagulation is an electrochemical technique with many applications, in which a variety of unwanted dissolved particles and suspended matter can be effectively removed from an aqueous solution by electrolysis. The main aim of this review is to present bench and field scale research studies for the EC and ECF technology to remove different pollutants from water and wastewater treatment plants.

2. Theoretical background on ECF process

2.1. Definition of electrocoagulation (EC)

Electrocoagulation is the process of destabilising suspended, emulsified, or dissolved contaminants in an aqueous medium by introducing an electric current into the medium. In its simplest form, an electrocoagulation reactor may be made up of an electrolytic cell with one anode and one cathode. The conductive metal plates are commonly known as 'sacrificial electrodes' and may be made of the same or different materials (anode and cathode) (Mollah et al., 2001). Electrocoagulation is the electrochemical production of destabilisation agents (such as Al, Fe) that brings about neutralisation of electric charge for removing pollutant. Once charged, the particles bond together like small magnets to form a mass. This process has proven very effective in removing contaminants from water and is characterised by reduced sludge production, no requirement for chemical use, and ease of operation (Rajeshwar and Ibanez, 1997). Colloid – destabilising agents that effect on-charge neutralisation are produced by electrolysis in the EC process. For example, aluminium anodes are used to produce aluminium cations which have the same effect as the addition of Al-based coagulants in conventional treatment systems.

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